Abstract

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Sustainable Disaster Recovery: Multiagent-Based Model for Integrating Environmental Vulnerability into Decision-Making Processes of the Associated Stakeholders

The goal of sustainable disaster recovery is to regain the built environment's functionality while decreasing the vulnerability of the society to future perturbations. This requires a new generation of decision support tools that integrate the host community's vulnerability assessment while taking into account the stakeholders' interactions, needs, and preferences. The available disaster recovery research focuses on the optimization and reconstruction of isolated projects rather than taking into account the host community's overall vulnerability and welfare. Moreover, the available research did not simultaneously take into account the stakeholders' preferences and needs. To this effect, this paper presents an agent-based model that integrates an environmental vulnerability indicator to better guide the decision-making process of the associated stakeholders. Such an approach will aid urban planners to redevelop societies into a more resilient status. This paper implements a five-step research methodology that comprises: (1) utilizing a comprehensive assessment tool to measure community’s environmental vulnerability (2) developing the objective functions and learning algorithms of the different associated stakeholders (3) modeling the different attributes and potential strategies interrelated with the different stakeholders (4) creating an interdependent multiagent-based model that concurrently simulates the aforementioned information and finally, (5) interpreting and analyzing the results generated from the developed model. The proposed model adopts post-Katrina recovery as the application domain, and thus was tested using the housing and infrastructure recovery projects in three coastal counties in Mississippi. To this end, the model was able to optimize and adapt to the changing vulnerability conditions of the host community. The model also provided an optimal utilization of the infrastructure to decrease the built environment vulnerability to future natural hazards. This provided better outcomes in relation to environmental vulnerability and stakeholders’ individual utility functions when compared to the actual implemented disaster recovery plans. For future work, this research will target the integration of other vulnerability indicators. This will lead to more effective representation of the host communities’ complex systems, and ultimately achieving a holistic sustainable disaster recovery.